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Epic of Life*

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It is only recently that the human mind has grasped the bold outlines of its own history and that of life on the earth. This triumph of unceasing inquiry into the nature of man and man's place in nature also lifts human beings a grade higher in the scale of living things. The many fragments of this long story of life rest securely in scores of volumes—the tributes of a dozen sciences. Can the contour and import of these many scattered fragments be fitted into a few pages? An answer is attempted in the following paragraphs.

The whole of the drama of life seems to have been performed in a very restricted zone—quite near to the very surface of our small planet. Even bacteria disappear in the upper reaches of the atmosphere, and other life extends downward only to the limits set by the ocean depths. At no earlier time in the earth's history has this been different. Fossil remains of living things are found in coal and rock strata now a few thousand feet beneath the soil on which we walk, but it is clear that these veins were land surfaces or ocean floors when they trapped the dead bodies of organisms. If we could look at the present living world from afar, say from the 24,000 miles which is one-tenth of the distance to the moon, we could rightly sense the narrow pinions of life. On the great sphere which would nearly fill our view to east or west we should then see all life imprisoned in a thin film—a living skin —tightly fitted to the very surface of the earth. As we now know it the entire story of life sticks to the place where there is liquid water; where gaseous oxygen, carbon dioxide and nitrogen abound; and where surfaces can absorb sunlight for a continuous flow of free energy.

Though the story of life is narrowly limited in locality or space it plainly fills an amazing lapse of time, and the year is an inconveniently small unit for reckoning its more significant chapters. Probably longest of all its long chapters was

* Reprinted from *Scientific Monthly*.

the period involved in forming those minerals and in attaining those conditions of temperature and moisture on the earth's surface which would lend to the building of the first and simplest living matter. When the huge quantity of earth-building material was first split off from the hot sun its temperature, mass and gaseous state gave assurance that hundreds of millions of years must elapse before conditions favorable to the origin of life could exist upon its surface. After its separation from the sun this gaseous matter cooled much faster than before, and although very few chemical compounds could exist in the superheated gases of either the sun or the new-born earth many such compounds were formed while the isolated earth slowly acquired lower temperatures. The formation of this great variety of new chemical substances was essential to the origin of life and also to its maintenance after it had arisen. Mixtures of extremely hot gases such as exist in the sun cannot undergo cooling to earth temperatures without chemical union, and some of these stable and durable combinations of heated gases are still being effected within the hot volcanoes of the earth today.

When the earth became cool enough to permit water in the liquid state to remain on its surface this earth of ours not only surrendered to the agent which would thereafter dominate and repeatedly remould its surface—and eventually destroy its daily rotation by tidal action—but it passively built the cradle for life. Forever thereafter water would accumulate in smaller and larger amounts in millions of pools; and always thereafter water would leach some chemical compounds from the diversified rocks, thus giving these compounds opportunity for ever new interactions in that unrivalled chemical laboratory—an aqueous solution. The forces that chilled a burning earth and formed its first pool of water also decreed that innumerable new combinations of matter—each combination with new properties—would appear on the surface of this planet.

In an almost equally significant way the gases which remained on this cooled earth, together with the sunlight which now became a sole and intermittent source of light and energy, assured a still greater variety of new chemical transformations—because these gases and light rays actively invade water. Under the superlatively favorable conditions of an aqueous medium, and for the first time in all our planetary history, these active agents of the air began their unending work on the water-held leachings of the rocks. Included in the earth's early atmosphere was a great store of prying active free oxygen; other oxygen which had tied carbon to itself and yet maintained the free and gaseous state as carbon dioxide; some hydrogen and rarer gases; and finally, a vast store of passive nitrogen—the nitrogen which had proved so largely immune to imprisonment in the great rock which is the earth, the nitrogen which still awaited the rendezvous at the pool—the water crucible—for nuptials with subtler compounds whose issue would exhibit the properties of life.

The next step in the long march of life attained the formation of organic matter from the plenitude of inorganic compounds and gases already accumulated. Probably in more generous quantity than now the surface of the youthful earth released a simple but very reactive gas, hydrocyanic acid or HCN. This gas, then as now, on dissolving in water gave rise to many organic and nitrogen-containing substances—such as urea and the amino acid, alanine. From still other sources various organic substances were

produced. The action of sunlight on carbon dioxide dissolved in water almost certainly gave rise to formaldehyde, sugars and other organic substance long before any microscopic particle even partially endowed with life arose in the pools and ooze of a warm young earth. Just as they seem still to do this in our time the colored surfaces of some flinty water-cups of a naked earth increased the rate at which the sun's rays built organic substances from carbon dioxide and water. The formaldehyde formed in this way could unite with the nitrate or nitrite leached from certain rocks and thus produce the very reactive nitrogenous substance, formhydroxamic acid; this acid, plus additional active formaldehyde, must then have produced a whole series of substances which are today the commonest constituents of plants and animals—purine, pyridine and amino acids.

With the creation of amino acids a further step could be taken toward the formation of fragments of brevetted matter —matter alive or partly alive. These amino acids are the blocks from which protein is built, and to this day all living matter is built chiefly of protein. Each molecule or building-block of amino acid has behavior and endowments—chemical and physical properties—which differ from those of any other kind of molecule. Such building-blocks can be put together in an almost endless variety of ways, with each new way yielding a new and different protein—and each new protein having one or more properties possessed by no other grouping of matter. Though nearly or quite two million living species now exist, each with one or more proteins peculiar to itself, perhaps no more than twenty-five different building-blocks are used in the construction of these millions of different proteins.

With the formation of protein molecules our earth was at the threshold of life. The viruses which cause such things as colds in humans, and mosaic disease in tobacco and asters, are particles of matter too small to be seen with any existing microscope. They are, however, probably pure proteins—and they possess one and only one of the properties of living matter. Under certain conditions they can divide and very exactly reproduce themselves. Though the virus may be said to be only half-alive it can be killed; but man, willow, worm and bacteria are killed far more easily. Again, those similarly minute and unseeable particles which in all living things bear the hereditary qualities—the genes—are in several respects similar to virus molecules. Probably both kinds of molecules are proteins; they are of about the same size; they both show a rare and peculiar form of instability or tendency to mutate; and both are able to reproduce themselves only when in contact with larger and more complex molecular aggregates which show all the properties of life. Probably no single gene standing alone is fully alive; but many genes are packed closely together in all living cells and since the various genes of a cell differ somewhat from each other their very juxtaposition or aggregation may add other elements of "liveness" to the aggregate. All really intimate unions of molecules are known to create properties not present in the uniting components; and gradations in "liveness" do exist. With these developments centering about endless labile compounds of carbon and nitrogen the phase of living substance may be said to begin, and the inconceivably long era that began with a few hot and mutually repellent gases in a burning fragment of the sun was ended.

It was also a very long way from the

simplest living cell to the man of a million years ago. But this long way was all the trail and unbroken chain of life, and since man has learned the cogent rule of that extended highway its course can now be roughly charted. In the great lapse of time the many genes within the simple single cells were able now and again to add new genes to the old store. Here each new gene meant a new type of cell—eventually a new race or species if the conditions into which it was born permitted it to live and reproduce. In still other cases cells ceased to separate after their division or reproduction, and the resulting aggregates—these groups of cells—gave rise to several sponge-like animals.

No event in the history of life is more notable than the earliest and unwitnessed case of dividing cells remaining attached to each other, getting mutual benefit from it, and preserving this state through all later cell generations. Few of the many primitive single-celled species accomplished this; but those that did provided the possibility for flower and fish and man. In these cell-communities, and also in the single cells which preceded them, there was occasional chance for offspring to start their lives with a set of genes which differed slightly from those of their parent or parents. By whatever means the genes were increased or were changed—and, in experiment, even X-rays have shared in causing genes to change—individuals and races of a new type were produced in that fraction of cases in which the changes were helpful; the luckless bearers of the still more numerous disadvantageous changes quickly disappeared without leaving descendants in the stream of life. Hundreds of millions of years provided many thousands of advantageous hereditary changes; and many thousands of superior species of plants and animals came to crowd and glorify the earth. Now and again during this period splendid species which had persisted for ages disappeared from the living scene, and their fossil remains tell of such things as changing climates and new enemies—things to which these once living forms could not adapt themselves.

One to five million years ago there were were several very superior animal tribes with expanding brains, all assuming more or less upright positions and developing skillful hands. Somewhere within or near this period one of these tribes markedly outstripped the others and its descendants became paleolithic man. The early performance of this man is not flattering to humanity in general, but probably we could not even approach an understanding of ourselves without some familiarity with this distant human ancestor. He and his neolithic successor reveal very much that is truly inborn and nakedly human—characteristics now much obscured in modern man by a capital thing called "social inheritance."

Primitive man required an unknown amount of time for learning to make a most simple tool—a flint for aid in obtaining food and subduing wild animals. But for hundreds of thousands of years thereafter this paleolithic man apparently made little further progress. Once he had made himself a bit safer from dangerous animals, and was assured of a somewhat readier food supply, he seems to have remained for thousands of generations almost as nonprogressive as a population of black bears. If paleolithic and modern man could meet they would be quite incomprehensible to each other; but the milestones between the two ages and the two men tell much. Tool-using man has been doing something on some parts of the earth's surface for perhaps five hundred thousand years. Yet it is probably only within the last fifteen or

twenty thousand years that he built his first city. Four hundred thousand years —tool-using man—but no city! A drab epoch of human futility; a brutal demonstration of primal limitations of raw untutored man.

Even the limitations of our somewhat more recent ancestors—those neoliths distant by no more than a thousand generations—are so evident as to require the consideration of factors elsewhere immaterial to the story of life. The man of today is or seems so different. How can we bridge the gap between him and his progenitors of thirty thousand years ago? That adjacent ancestor was probably equipped with nearly or quite as good heredity as are most men of today. Neither structural changes occurring in man, nor changes in the genes carried by him, adequately account for the changes that have occurred in man during the last twenty or thirty thousand years. Those changes came largely from social forces born with the discovery and extension of agriculture, the invention of alphabets and wheels, the domestication of animals, and the use of metals and harnessed energy. These external things —created doubtless by a clever few and shared by all—brought security, plenty and leisure; and they also supplied the foundations for written language, accumulated experience and able leadership. No human being thereafter grew up as his mere primate self, but from infancy onward he was permeated by much that his race had already accomplished—a thing not possible to any other living species and a thing scarcely evident in primitive man during some hundreds of thousands of years.

Thus the long trail of life leads to modern man—the winner of an age-long race between many brothers. Like the sparrows he arrives not as a single breed but as several. Though these races have not been physically blended by the external or social things of their own creation they already begin to understand each other. In numbers far greater than at any preceding epoch the living bodies of man now caress the hemispheres. His art and labor have laid a friendly, fruitful, chequered sward upon a planet. His growing mind has gripped the sun, moon and a hidden universe of stars—and wrested speech from buried milestones of his own path of many million years. With the mantle of these triumphs about him modern man now exalts both himself and his hardy groping ancestor who painfully shaped a flint.

STUDENTS' SCIENCE CONGRESS AND CHRISTMAS LECTURES

Teachers and students in the vicinity of New York City have come to anticipate as a high spot of the fall term the annual Science Congress and the Christmas lectures sponsored by the American Institute of Science and Engineering. Patterned after the adult meetings of the American Association for the Advancement of Science, this convention of student scientists gives the opportunity to club members to present talks and demonstrations in all of the various branches of science.

PROGRAM OF EVENTS

December 18, 1939, at 4:00 P.M.—Lectures by Professor Chambers and Dr. Taylor. Auditorium, Museum of Natural History.

December 27, from 10:00 A.M. to 4:00 P.M.

December 28, from 10:00 A.M. to 1:00 P.M.—Students' Science Congress, Education Hall, American Museum of Natural History.

L. ORENSTEIN
J. W. HAMBURGER

A Modern Teaching Aid

MARY ROGICK
College of New Rochelle

Statement of the Problem

A great deal of time and energy is spent by the biology teacher during a laboratory period teaching individual students how to see what is under the microscope and how to interpret what they actually see. Much of the time so spent benefits only a limited number of students while at the same time it wears out the teacher both physically and mentally. The problem resolves itself into two phases, namely:

1. How to reach the greatest number of students in the most effective and interesting manner, with the greatest economy of class time, and energy and effort on the part of the instructor or laboratory assistant.
2. How to give each student the benefit of a full period of intelligently explained, purposeful laboratory activity, as opposed to the ordinary procedure of giving each student 3 to 5 minutes of individual attention then leaving him to the mercy of the laboratory manual, mimeographed instructions, work book or his own devices for the remainder of the period while the instructor busies herself with another student.

Devices for Solution of the Problem

The type of material to be covered during the laboratory period would of course influence what method or combination of methods and devices should be used to best advantage. However, the following two or three devices are most essential in solving the problems mentioned above. One of them is the ordinary compound microscope. Another is some type of microprojection apparatus. A third, very useful and time-saving but not absolutely essential, is the mechanical stage, a device which attaches directly to the stage of the microscope and which facilitates the movement of slides. Microscope accessories such as 5 ×, 7.5 × and 10 × oculars and 4 ×, 8 ×, 10 × and 43 × objectives are quite necessary and should be available for the demostration microscope. The projection apparatus, of which there are probably a number of types on the market should be such that it will project on the wall whatever is on the microscope stage. The microscope should be in its normal upright position, otherwise, living material cannot be demonstrated. It is advisable to set aside one microscope for use in demonstrations, leaving on it the various attachments which are needed for projection work. Thus, it is ready for instant use when needed. A special screen is not necessary, satisfactory results being obtained with the use of a large sheet of white cardboard, or the backs of wall charts.

Method

Of the various teaching aids, board drawings, charts, models, lantern slides, etc., the writer has found the microprojection apparatus to be one of the most valuable teaching and time-saving aids or devices. It can be used with equal worth in classes of biology, botany, zoology, histology, embryology, microtechnique, etc. The procedure in using this demonstration method is somewhat as follows: First, the microprojection ap-

paratus, screen, microscope, etc., are set up before the laboratory period and checked to see that everything is operating perfectly. Second, the demonstration slides are carefully picked out ahead of time. Third, living material, clean slides, cover slips, pipettes and other essentials should be on hand before the period begins. Fourth, when class assembles, the necessary laboratory instructions are given, orally, in written form, or both. If most of the period is to be devoted to microscopic work the instructor can begin her demonstration immediately after the general instructions have been issued. After students seat themselves close to the demonstration table the instructor can begin.

In showing permanently prepared slides she should not only point out the structures and their relation to each other but should also make sure that the students understand about sections and their relation to the whole animal. In showing living material she has the opportunity to discuss the animal's activities, physiology, needs, structure and possibly method of reproduction. Living demonstrations (microscopic worms, parasites, insect larvae, numerous aquatic forms, rotifers, rock scrapings, pond scum, circulation of blood in tadpole gills or tail and circulation of protoplasm in some plant cells) are always exciting. A number of temporary mounts made by dissecting out structures from living or preserved animals and placing these under the microscope sometimes prove very useful. Sometimes the idea for such a demonstration may arise spontaneously from the students. After the microprojection is finished, the students return to their regular laboratory places. They are then given the slides, specimens and such material as is to be studied during the remainder of the period. By this time they have a clear idea of what to look for, how it should look, where they will find it and what relation it has to the day's laboratory exercise. They can begin their work directly, without much waste motion or uncertain floundering.

Applicability of Method

This method is particularly helpful during the first few periods when students are learning how to use the microscope. At this stage they usually have difficulty distinguishing between such simple things on their slides as air bubbles, debris, structures and different microorganisms. A class can be saved much time if some of these things are pointed out to it early in the period. Such points as focusing, the effect of using various powers of ocular and objective, the effect of closing the diaphragm, the extent of the field under different magnifications and the effect of using dirty lenses can all be very satisfactorily demonstrated by microprojection. This method is also well suited to the following situations or demonstrations:

1. Diffusion currents due to the mixture of two solutions, a dye (as methylene blue) and water.
2. Formation of crystals.
3. Dark-field illumination.
4. Interpretation of histological sections.
5. Following the development of a particular structure or organ through serial sections of embryological material.
6. The constructive, critical examination before the microtechnique class of slides made by its members.
7. Oral quizzing.

When the instructor is busy, occasionally some students will form a small demonstration group during the laboratory

period to straighten out a histological or embryological problem which is puzzling them. It is most gratifying to watch such a group earnestly trying to figure out some point among themselves, projecting various slides, hunting for structures and comparing the slides with text figures.

A wide variety of material can be effectively demonstrated to the class in a relatively brief time with the assurance that every student has had a chance to see each demonstration. The older system of setting up a number of microscopes, each with a labelled demonstration, takes far more time to set up and is not so certain of equally effectively reaching all students. During a microprojection demonstration better students often ask questions which the poorer or more timid ones had not thought of or had not dared to ask. In this way all students get the benefit of the discussion which ensues.

This type of lesson helps not only the class but also the instructor. She must carefully look over her slide collection and select those which are most typical and others which are least so. She must be prepared to give an intelligent, knowing interpretation of each slide. Hence she is apt to be better prepared when class meets than if she were to use some other method.

It might be added here that interest in classroom cultures and aquaria (fresh water or marine) can be stimulated by frequently taking specimens, samples, debris, algal growth or other material from the aquaria and projecting them for the benefit of the class.

Summary

This microprojection - demonstration method is applicable in a number of biological courses. It is of considerable benefit to the student because it very effectively reaches the whole class at the same time and in the same way. It saves the student time and the teacher much repetition during the period. It requires much better preparation on the part of the teacher for each period, a condition which both the teacher and the student should welcome.

Biology through the "Five-and-Ten"

ETTA M. PETTYJOHN
Overbrook High School, Phil., Pa.

With increasing emphasis on motivation in Biology through living materials, pictures, charts, supplementary reading and projects, so frequently impeded by curtailed funds for such purposes, the teacher faces a problem of how to get the most for each expenditure. Today, the teacher has at her disposal a "supply-house" where selection can be made at the counter and the article procured at once on a "cash and carry" basis. No longer need one wait for days for some of the minor supplies so essential in a vitalized biological laboratory. A short trip to Main Street or Market Street enables one to procure for a small sum invaluable teaching aids.

It has long been possible to purchase "realia" at the five-and-ten cent stores; but with each visit one discovers added stock. At the fish counter, guppies and their kin have joined the ever popular

goldfish. Scavengers, such as snails and newts, can be secured for the fresh-water aquarium along with such water plants as vallisneria and sagittaria. In fact, serviceable aquaria can be bought very reasonably with sand, pebbles, dip-nets and food for some of the larger animals. The "all-glass" aquaria can be used for marine purposes if one is near enough to the shore to secure barnacles, hermit crabs, starfish, sea-anemones, sea-cucumbers and "sea-lettuce." Such an aquarium requires more care than a fresh water set-up, but it is a source of never-ending interest for the pupils.

At the same counter, one can find in many stores canaries and bird supplies both for those in cages and our out-of-door feathered friends. Bird baths, supports for suet-trees and cuttle-bones (also useful in mollusk study) offer material for bird observations.

Turtles require a minimum of attention and the small Western Turtles sold at the "five-and-ten" prove satisfactory in securing interest in reptiles. They have thrived in biology laboratories for years.

At the Easter season, chicks can be secured which offer great possibilities for such experimental studies as feeding habits, and maze-set-ups to test the animals' rate of learning. If students assume the responsibility of caring for the chicks, they can be raised in school, inciting great interest in the laboratory.

Potted plants of good size and quality as well as bulbs for indoor and outdoor growing are reasonable in price and never fail to awe children with the wonder of their development.

A few packages of seeds can afford a great stimulation to the classroom. By mixing them and permitting each student to plant the unknown (to him) mixture, one secures careful daily observation of the seedlings to determine their identities.

Modelling clay and soap offer excellent media for constructing forms for habitat groups. To these can be added the small wooden or plastic animals in such abundance at the Christmas season. An inexpensive sponge may be clipped to size for an underwater scene or used moistened to raise radish seedlings.

An economic significance of the mollusks can be shown in the shell-covered boxes, candle-holders, ash trays, etc. And for ten cents one can purchase a necklace of coral to illustrate a use of a coelenterate.

The field glasses of the "five-and-ten" can be used to advantage where better instruments are not procurable, as can the microscopes and film strips.

There is a seemingly endless number of uses for the "five-and-ten" offerings in the laboratory. Dry cells can be used for countless experiments. With a snake-rattle mounted on the armature of a door-bell, one can approximate the snake's normal frequency of vibration. The sense of touch of an earthworm can be determined by its reaction to an electrically charged piece of sand-paper. Such topics as birds, leaves and flowers can be studied through an electric questionnaire board.

Creditable diagrams can be made on "five-and-ten" window shades. Several of these can be mounted on two extension boards so that any one can be lowered on demand.

The ingenious teacher can find biological class material at practically every counter. Cheese-cloth and a wire coat-hanger make an efficient insect-catching net. A glass caster can be used with a shell or butterfly and plaster of paris to make an attractive paper weight. The stamp-counter can be a stimulus for

an interest in philately of a biological nature.

Bulletin-board material of good quality can be obtained by removing the picture-pages of the larger plant and animal books. The picture counters have been specializing recently in excellent flower-prints in accordance with the interest in the Victorian era.

Many of the "five-and-ten" books are an addition to the biology library or the book-table in the laboratory. Such books as the following are remarkable values for ten cents.

Ashbrook, Frank G. *The Green Book of Birds of America.* Racine, Wisconsin: The Whitman Publishing Company, 1931. Pp. 95. (One of a series of three bird books.)

Bailey, Alfred M. *At Home with the Birds.* Chicago: The Merrill Publishing Company, 1934. Pp. 15. (A book on nesting habits with pictures painted from life by Earl G. Wright.)

Fazzini, Lillian D. *Bugs of America.* Racine, Wisconsin: The Whitman Publishing Company, 1937. Pp. 94. (Color illustrations.)

Fazzini, Lillian D. *Butterflies and Moths of America.* Racine, Wisconsin: The Whitman Publishing Company, 1934. Pp. 96. (A pocket-size volume with sixty-four color illustrations.)

Harvey, John. *Wild Flowers of America.* Racine, Wisconsin: The Whitman Publishing Company, 1932. Pp. 70. (Illustrations by Irving Lawson.)

King, Julius. *Birds.* Cleveland: The Harter Publishing Company, 1934. Pp. 60. (One of a series of three books by the same title.)

King, Julius. *Talking Leaves.* Cleveland: The Harter Publishing Company, 1934. Pp. 62. (A manual illustrated by Evan Thurber containing fifty-nine of our most familiar tree leaves.)

Lawson, James G. *Wild Animals.* Chicago: The Rand McNally Company, 1935. Pp. 64. (Photographs and descriptions of one hundred important wild animals.)

Mills, Lewis H., and Hawkins, Gertrude. *Book of Birds.* Chicago: The Rand McNally Company, 1937. Pp. 15. (Illustrations by Walter A. Weber.)

Morgan, Leon. *The World a Million Years Ago.* Chicago: Magill-Weinsheimer Company, 1933. Pp. 10. (Illustrations by H. G. Arbo.)

True, Josephine M. *The Busy Honeybee.* Chicago: The Rand McNally Company, 1936. Pp. 63. (An account of the activities of the honeybee with pictures of bees and their hives.)

Zwetsch, James C. *First Aid.* Racine, Wisconsin: The Whitman Publishing Company, 1937. Pp. 91. (What to do in case of accident or sudden illness.)

The teacher who has not yet acquired the "five-and-ten" habit has an interesting and valuable experience ahead in vitalizing the biology program.

Wessell, J. P.
Some Laboratory Aids in Zoology.
School Science and Mathematics, 38: 614–618; June, 1938.

By means of ingeniously devised plaster and wire models, the author and his students have illustrated complicated anatomical structures. Models showing the distribution of the peritoneum of the earthworm, and the circulatory systems of the earthworm, dog-fish, and cat are pictured and described.

Gray, H. A., *The Instructional Sound Film in the Service of the Classroom Teacher.* Educational Method, 18: 65–68; November, 1938.

Using a film entitled "Conservation of Natural Resources" as an example of how a film can be of value to the classroom teacher, Mr. Gray discusses the advantages of such a film to teaching. He also describes the methods of deriving the greatest benefit from its use.

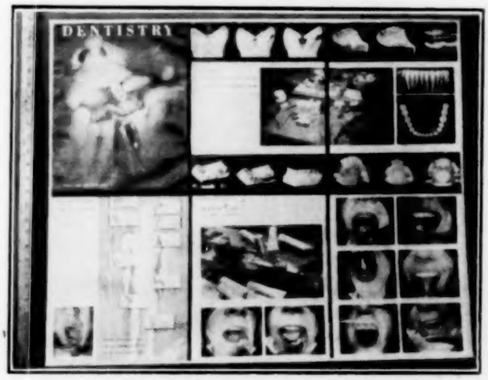
Biology Teaching Aids

FLETCHER J. PROCTOR
Concord Senior High School, Concord, N. H.

Several excellent papers on this subject have already appeared within our pages and without doubt they have been greatly appreciated by the readers.

The enlightening article by Dr. Heiss on "Flat Pictures" stimulated me to write this account of teaching aids that have been successfully used in all our biology classes. In regard to flat pictures several popular illustrated magazines constitute a fertile source and our pupils are constantly on the alert for pictures which have a bearing on biological subjects. When a suitable series, such as a recent dental covery, is brought into class we treat them in the following manner. They are arranged in their original order on a piece of strawboard or even a large piece of a cardboard packing case and stapled around the edge to hold them in place. Any corners that cannot be reached with the stapling machine are tacked down with glue. Lines, formed where pictures meet, are covered with strips of quarter-inch lantern slide tape which is purchased already gummed on one side. It is black and contrasts very well with most pictures. A small sponge is used for moistening the tape. To give the laboratory-made wall charts a finished appearance the four outer edges are bound with white book binding tape which is one-half inch wide and also conveniently gummed on one side. Two small holes punched at the top and about one-half inch in aid in hanging such charts on the wall or they can be stood in the chalk tray if desired. Pupils like to make charts in this manner and are naturally pleased when one of their charts is hung in the biology room and used in the class work. Teachers have actually gained the interest and cooperation of some pupils through this medium alone. Our objective along this line is to work up suitable visual material to accompany all our laboratory experiments, exercises and demonstrations. Such material is inexpensive, easy to make and has many educational advantages.

One problem that must be considered by most schools in regard to teaching aids of any type is the cost. Our school is fortunate in this respect for we possess many commercial models and wall charts. In spite of this fact we prefer to make certain models in our own laboratories because of the low cost involved and the added interest shown by pupils in models made by themselves. They also gain a great amount of information while numbering their models and making keys to accompany them. The method used, by

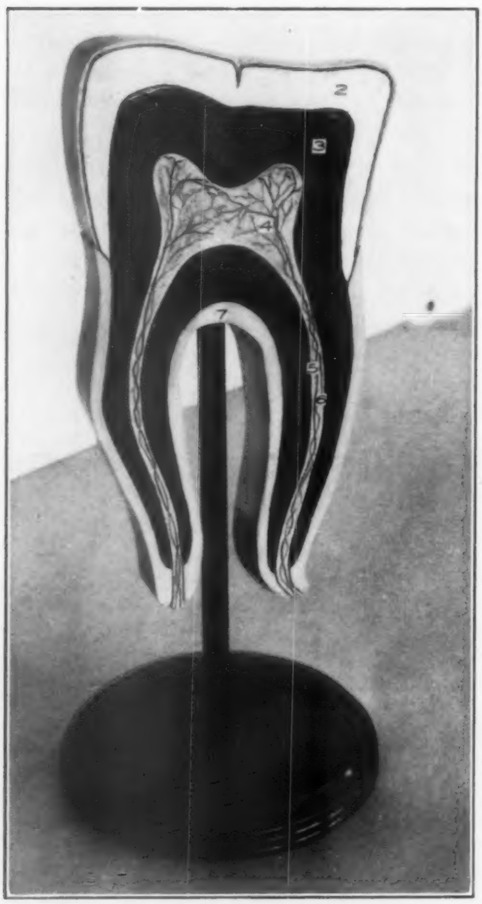


Reprinted by courtesy of Life magazine

WALL CHART

Inexpensive and carefully selected visual material help both teacher and pupil.

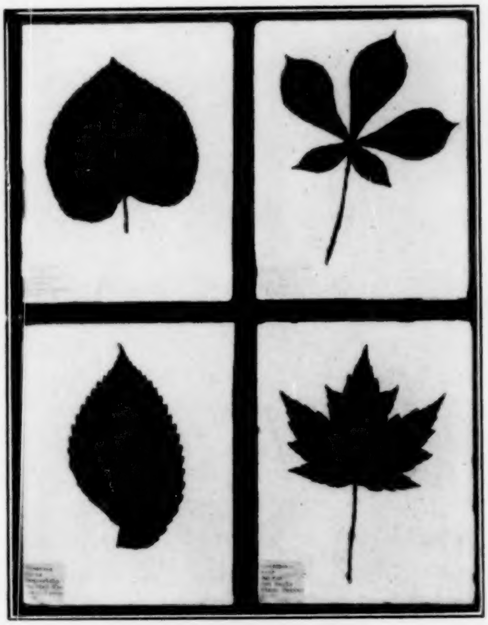
our pupils, to make a cross-section model of a corn seed is as follows. First make a plaster of Paris block $6'' \times 11'' \times 1''$ by mixing the plaster and pouring it into a cake tin or, even better, a pyrex cake dish, for the latter gives the finished block a nice gloss. A pyrex dish also gives the worker a chance to make sure that no air bubbles form on the under side of the block for that will be the working surface. Before starting the dish should be coated thinly with lard, Spry or olive oil. If the finished product is to be mounted as a plaque with wooden background a means of attachment must be provided before the plaster sets up hard. Ordinary paper clips that have been straightened out can be partially imbedded in the plaster while it is still pliable. After this has been done allow it to set for a day or two and the block will easily leave the dish when the latter is inverted. The next step is to make an enlarged cross-sectional sketch of a corn seed. This should be made from an actual dissection observed under a dissecting microscope to insure accuracy. After an accurate drawing has been made place a piece of carbon paper under it and trace the drawing on to the working surface of the plaster block. If done carefully the tracing will serve as an easy guide for the carving operation which can be completed with an old scalpel and a sharp implement such as a geometry compass. Use the latter to trace little trenches where outlines are desired and ink them in with Higgins red or black ink. Trenches keep the ink from spreading. If colors are needed to make certain areas stand out ordinary water colors will do very well if water us used sparingly. Numbers for identification of parts can be made on a typewriter, cut out and pasted on as desired. Any scratches or rough edges that remain after the carving is finished can be smoothed out with a small strip of fine sandpaper. Colorless fingernail polish will serve well as a protective coating and leaves a nice gloss on the finished product. Plaques and models have been made by the above method at costs as low as fifty cents each; for example, our model of a tooth cost exactly that amount. The tooth was made by one boy and the painting and numbers were added by another. The base was turned, painted and attached by a third pupil whose interests center around woodworking. This venture added another step to the "technique" for it was found that plaster of Paris can be drilled very easily



Plaster of Paris Model

and that cement will hold the shaft of the base tightly into the model itself. The important thing to remember in work of this type is that pupils must do it all or the real educational values of such projects are lost.

Plaster of Paris leaf prints are also wonderful aids in a study of compound and simple leaves, veining and leaf margins especially at times of the year when live material is not available or is difficult to obtain. Grease the pyrex dish used previously and arrange a leaf on the bottom. Mix a fine batter of plaster and pour it over the leaf, being careful that none gets under the edges and that the specimen does not move. Put the dish away for a few days until the plaster has dried out and then remove the cast as described previously. Leaves usually adhere to the plaster but are easily stripped off leaving an excellent print which will show all the required parts. To finish the plaque paint the print with colors to match the actual specimen, using a fine brush. A good leafgreen paint can be obtained at any five and ten cent store.



PRINTS
Leaf prints in plaster of Paris.

Work of this nature is instructive and interesting and through it teachers are always able to stimulate some of the otherwise hard-to-reach pupils.

SIMPLE METHOD FOR PRESERVING GREEN ALGAE

Students will bring into the laboratory algae common to their locality, but for a greater appreciation of the varieties and forms of these beautiful plants, preserved specimens play their part too. Perhaps Pediastrum, Ankistrodesmus, Scenedesmus, Chlamydomonas, Characium, and other equally interesting genera, would never be seen by many of the students were it not for the preserved forms. Such a study need not be exhaustive, and the names are inconsequential, but the student's experience will be enriched by these added observations.

Green and blue-green algae may be preserved indefinitely and perfectly, even as to color, in a saturated solution of copper sulphate in formaldehyde.

With many of the more conspicuous forms of aquatic algae, such as Oedogonium, Zygnema, Mougeotia, and Hydrodictyon, it is easy to drain off most of the water, and then pour the afore-mentioned solution over the moist specimen. However, in cases where the algae are minute, it is more practical to allow the majority of them to collect in the bottom of the container, drain off as much of the water as possible, then add the saturated solution.

E. CORNELIA TROWBRIDGE,
Pekin Community High School
Pekin, Illinois.

The Biology Teacher and the Appendicitis Deathrate

ELLA THEA SMITH
Salem High School, Salem, Ohio

The biology teachers of the United States might easily be instrumental in helping to save 20,000 lives annually in our nation, if they would unite in an effort to meet the challenge of Dr. Mont R. Reed of the School of Medicine of the University of Cincinnati. Dr. Reed, a very able surgeon, issued this challenge to schools in a speech delivered to the Southeastern Surgical Congress in Atlanta, Georgia, on March 6, 1939. In this speech, Dr. Reed cited the fact that, until 1938, the United States led the world in deaths per 100,000 population from appendicitis. Previous to 1938 our deathrate was about 16 per 100,000 and even in 1938 it was 13 while some countries have a deathrate as low as 3. This, said Dr. Reed, is a national scandal, especially since no one needs to die of appendicitis, if only all the people of this country can be taught a few simple facts.

Dr. Reed adds that we shall have to throw the problem of teaching these facts into the laps of the schools, if any real progress is to be made soon. He says that along with the three R's, the schools should teach the few simple facts that will enable students and their families to avoid death from appendicitis. Cincinnati schools have done something along this line already and have accomplished more than all the clinics conducted for adults.

There is extensive discussion among modern educators of the need for teaching students in such a way that their learning will function in their daily living. In this matter of education to prevent deaths from appendicitis, the biology teacher has a unique opportunity to do some teaching that will function, and function in a way that is easily observable.

It so happens that during his period of training the prospective biology teacher is not commonly taught the facts that must be known to avoid serious results from appendicitis. For this reason it may be well to cite the facts in the pages of THE AMERICAN BIOLOGY TEACHER.

First of all, there is the fact that acute appendicitis is almost never fatal unless the appendix ruptures and the pus thus set free in the abdomen then produces general peritonitis.

Secondly, there is the fact that most cases of a ruptured appendix are the result of taking castor oil or some other laxative for "stomach ache" or pain in the abdomen. Statistics show that in one year 20,000 persons died in the United States from a ruptured appendix. Of these, 18,000 were known to have taken a laxative for a pain in the abdomen.

Thirdly, there is the fact that any pain *anywhere* in the abdomen may mean that the person is having an attack of acute appendicitis, if his appendix has not been previously removed. Many persons labor under the false impression that the pain must be in the right side to mean appendicitis. As a matter of fact, the pain with appendicitis rarely begins on the

right side. It may be anywhere in the abdomen in the early stages. Later the pain usually does localize on the right side but by that time, the attack has frequently reached the danger point, when rupturing of the appendix may soon occur.

Fourthly, there is the fact that appendicitis is easily and completely curable, if the appendix is removed before it ruptures.

Fifthly, there is the fact that one third of all cases of appendicitis occur in persons of high school and college age.

Sixthly, there is the fact that no one should be afraid to call a doctor when he has a pain in his abdomen for fear it may be appendicitis. Actually, he should be afraid *not* to call a doctor. The danger, almost the only danger, if laxatives are avoided, comes from waiting too long, since the appendix may rupture in as little as six hours from the beginning of the pain.

Students of biology should be taught these six facts along with the following hard-and-fast rules to be followed rigidly in any case of pain in the abdomen, if the appendix is still *in situ*. If these 4 rules are rigidly adhered to, the patient need not fear death or any permanent ill effects from appendicitis.

1. Do not take castor oil or any other laxative for any pain in the abdomen.
2. Do not eat anything at all (water may be taken safely) in any case of pain anywhere in the abdomen.
3. Do not do anything that takes much activity; in other words, keep quiet.
4. If the pain lasts for four hours, call a doctor at once, and do what he says.

One or two class periods will be sufficient to teach these facts and rules. Students will contribute eagerly actual cases from their own experience that will help to bring reality into the teaching. Reporting on one actual case of death due to taking castor oil for abdominal pain (and they are shockingly frequent especially in small communities) will make an indelible impression. The facts are not readily forgotten when reinforced by direct personal experience. Repeating the four rules daily for a week, making posters showing the 4 rules for the school bulletin board, or writing an article for the school or local paper will make this information a permanent part of each student's thinking.

Undoubtedly, many biology teachers are already doing what Dr. Reed suggests in this matter of education to prevent death from appendicitis. But the wide publicity given Dr. Reed's article in the newspapers only emphasizes the need for all biology teachers to be alert to this unique opportunity. Surely it is infinitely more satisfying to teach a student a few facts that may save his life tomorrow, or that of some near relative than to teach him to name all the parts of the grasshopper from the palps to the ovipositor. Biology is unique in that it offers so much that is functional. The emphasis is shifting from memorization of technical terms to that portion of our subject matter that really functions in the student's daily living. No more startling example of the opportunity to do functional teaching can be cited than this matter of making biology courses help to lower our disgraceful deathrate from the common and easily curable disease called appendicitis.

A limited number of back copies of The American Biology Teacher are available. Numbers 4 to 8 (January–May, 1939) of Volume I may be secured for fifteen cents per copy, remittance with order, from P. K. Houdek, Secretary-Treasurer, Robinson, Illinois.

News and Notes

THE CHICAGO BIOLOGY ROUND TABLE

The Chicago Biology Round Table began its fall program under the newly adopted constitution and by-laws. These new regulations were perfected by a committee led by Miss Enid Hennessey. During the past several years the organization has been functioning mainly through tradition stimulated by the memory of a former set of regulations now reposing somewhere in the archives of the group.

The present constitution and by-laws defines the objectives of the club, makes provisions for officers and committees, and clarifies procedures. One important innovation was the creation of the office of corresponding secretary, the duties of which are to serve as a liaison officer with the National Association of Biology Teachers and other related groups both of a national and local nature.

The 1939–1940 officers consist of the same personnel as last year but with the addition of one new member. Mr. I. P. Daniel of Lake View High School and former vice-president for several years succeeds Mr. Lichtenwalter of Lane Technical School as president. Miss Ruby Fremont of Calumet High School retains the treasurership and has the new title of recording secretary. Her duties are similar to those of last year. Miss Thelma Jones of Bowen High School was the new member elected this year. Miss Jones has the vice-presidency and is chairman of the program committee—the latter is a vestment of her office. Mr. Lichtenwalter, immediate past president of the organization, consented to serve for the time as corresponding secretary. His previous contact as immediate past president of both the local and national organization will aid the organization in this connection.

As we go to press the details for the November third meeting program are not available. It will, however, follow closely the precedent of former years of having formal lectures by outside speakers of national or regional importance alternated with presentations by members of the organization doing unusual jobs of teaching. The December eighth meeting will be held in the evening at six-fifteen. The program will be preceeded by a dinner at the Medical and Dental Arts Building in the cafe on the twenty-third floor. Anyone interested in the activities of the organization is always welcome.

M. C. Lichtenwalter

The Biology Library

MELVIN A. HINTZ
So. Milwaukee High School

During the last few years most schools have taken more than usual interest in their libraries. More money has been included in the budget for new books and for other reading matter. In many progressive schools the library is the real center of activity in the school, as it is the source as well as the clearing house for the solution of many of the intellectual problems of students. The central library has been called the "Heart" of the school because from it lead the many avenues which open unto a new world for many students. The central library is the clearing house for all of the books used in a school. Here the books are catalogued and made available to those who seek more than just the minimum required. Books in this library are selected from lists submitted by the teachers in addition to those selected by the librarian. In an arrangement like this the science books, especially those in the natural sciences, are selected by persons who are better acquainted with the needs of the students and consequently books are selected which are used by the students. Most librarians select science books after they have consulted with the science teachers and here again useful books are selected.

In our high school a problem arose which if it had not been remedied would have worked a hardship on the students. Our library, even though quite large, could not accommodate all students who wished to go there for reference work during their study periods. In order to give the biology students all available opportunity to do as much reading and reference work as they had time for, we established what we call "A Branch Library" in the biology department. Biology has a branch library, Chemistry and Physics have one also. When a teacher begins a unit of work he goes to the central library and selects all available books which will be of value and these are brought to the room for the students to use in addition to those general references kept in the classroom the year around. A student librarian, who is a member of the library club, looks after the branch library, which may be in a room next to the biology classroom or a separate space set aside in the room as a library section. Chairs and tables are at the disposal of the students. Instead of taking reference books to their desks they go to the library section or to the library room adjacent to the classroom to do their reading. Students can draw out any of the books, but only over night. When a student finds that he wants to get additional information in addition to that given in the basic text he is permitted to go to the library section or library room, and there finds all available material on a given topic that the school has. On certain topics there is also available other material in the central library, as only the more important references are to be found in the branch library.

In selecting the books for biology, care has been taken not to overload in any one branch of biology, but to get suitable books in the various fields. It is in this way that one can have a nucleus for a good biology library, and one which can be built up according to the funds available. There are at present not very many books written especially for high school students, but if a teacher uses care and foresight a good number of reference

books which deal with the materials of biology can be made available to the students. High school textbooks in biology are the most common books one finds in most biology classrooms or libraries. These may serve their purpose, but from experience I have found that the better students do not find them complete enough to meet their needs. If one is to encourage reading in the natural science field we will have to offer something more than high school texts. College texts in most cases are valuable as reference material, but today we have a few so-called "popularized" presentations of materials of biology and also books written on biological material for the "laymen." This type of book seems to be popular with the students and the ones most used. In addition to the books many teachers have many pamphlets which are secured from a number of sources.

In order to encourage students to do more reading, especially in biology, we have asked the students to read each week one article from a magazine and one article in a newspaper—each to be on some phase of biology or of a biological nature. We call this assignment, "Biology in the Press." Each student is given a five by three card on which he writes the following information: Name of magazine, date, name of article read and length of article, either in pages or inches; name of newspaper, date, name of article read and length in inches. On the other side of the card the student writes what interested him most in each of the two articles read. In this way the student is brought in contact with the latest developments in biology as they appear in the press. After this plan was introduced we found that the magazines in the central library were in constant use and many students could not read the magazine they desired. To solve this problem the administration orders special copies of the most used magazines and places them in the branch or classroom library, where students can read, either before or after school, or during class period when they have time.

Our little reading program has created more genuine interest in biology and more than doubled our use of reference books. The extensive use of reference books is partly due to the fact that the students want additional information to help them better understand some of the things read in the press. Another significant point is that the little reading in the press has opened many new avenues for investigation in the field of natural sciences for these young people. It has been a great help to demonstrate to the student that biology plays a major rôle not only in his every day living, but in the world as a whole. As a result of this reading we now have quite a number of students carrying out various experiments. At present the work on soil-less plant culture is most popular. If all biology teachers will just take a little time to organize and develop a biology library, the boys and girls will come in contact with the better reading material and the young people will leave school with a broader understanding of the marvels of the living world, which can not be gained if they have only a basic text.

BOOKS

Gruenberg, Benj. C., *High Schools and Sex Education.* Published by the U. S. Public Health Service.

More than a decade and a half ago, the United States Public Health Service, in cooperation with the Office of Education, issued its bulletin *High School and Sex Education.* Since the day in 1922 when this "manual of suggestions on education relating to sex" made its appearance, far-reaching changes have taken place. Adequate in its time—as shown by the distribution of twenty thousand copies—so many developments have taken place since that it became necessary for the Service to re-examine and re-evaluate the entire field of sex education.

Thirty years ago—fifteen years before *High Schools and Sex Education* made its appearance—half the adult population dropped out of school at the age of thirteen and did not go beyond the fifth grade. Today the parents of secondary school pupils are much better prepared to consider the educational needs of their children than parents were three decades ago. Many of them have had more education than they could have had before, and, as time goes on, the grade level at which most students drop out will probably be raised even higher.

This educational advance makes parents more articulate. It causes them to demand better orientation for their young people to the problems of adult life. It makes them increasingly aware of their children's need for solution of the problems of adjusting to the opposite sex in preparation for marriage and family life.

Nor have teachers been unaffected by the changes which have been taking place. Advances have been made in the philosophies and technics of education. Just as parents are demanding better orientation in this world of ours for their children, so teachers are more aware today of their general task in guiding their adolescent students into mentally and socially healthy adulthood.

In the seventeen years since the Public Health Service issued its manual, standards of teacher-training have been raised. Scientific literature, once the esoteric province of the professional psychologist, and psychiatrist, has become one of the tools of the educator. Studies of the emotions and of problems of personal adjustment have, to some extent, become familiar to all secondary school teachers.

Perhaps the most dramatic evidence of the new general awareness and willingness to face our social and educational problems is the reception accorded the campaign against the venereal diseases, started by Surgeon-General Thomas Parran, which has been in progress for more than two years. For secondary school teachers, this is of significance. Venereal disease, important though it is, is but a part—a spectacular phase—of the whole field of sex education. The fight of the American people against venereal diseases is an indication, which educators cannot ignore, of the public's readiness and eagerness to have its young people prepared sanely and rationally for adult life.

For these reasons, the United States Public Health Service came to the conclusion that the whole field of sex education had to be re-explored. To meet the new attitudes and new conditions, preparations were made to reissue the manual and Dr. Benjamin C. Gruenberg was added to the Service's staff last year to revise it.

The revised *High Schools and Sex Education,* by Dr. Benjamin C. Gruen-

berg and J. L. Kaukonen, is based on the premise that the schools must assume an increasing responsibility for the health, character, and social education of young people. A series of lessons or a course on "sex education" is neither sufficient in itself nor desirable as an isolated part of the secondary school curriculum. "Sex" is not an isolated phenomenon which can be explained adequately in terms of itself only. "Sex education" in the true sense can only be taught as part and parcel of all the courses in the curriculum. Thus the social science teacher, the teacher of literature, the home economics teacher, and the physical education instructor—all have their responsibilities as do the teachers of biology, physiology, and hygiene.

The physiological facts of sex are important for young people to know, but they should also understand its emotional and social repercussions. Teachers who give information only about mammalian reproduction or who confine their teaching to simple answers to simple questions about personal hygiene are doing only a part of their job. That students should acquire knowledge is important, but they should also be given guidance for its use. On the whole, teachers today recognize that need. They have an appreciation of the many forces which affect personality and its development. They see the application of their special fields of teaching in terms of the broader needs of the adolescent for guidance in mental and social health.

Biology teachers are in a strategic position to help unify the adolescent's experiences into that which makes for mental and social health. By teaching basic biological facts sanely and unemotionally and by showing how, because of these facts, we function in a social world, the biology teacher makes his real contribution.

In addition to showing the part which should be played by teachers of all subjects in the field of "sex education," the revised manual contains several chapters on the general aspects of the sex problem as it affects the secondary school. It concerns itself with school organization and management, training of teachers, the use of extra-curricular resources and—even more important—cooperation with parents and community agencies in guiding and training young people.

In addition to revising the teacher's manual, which was ready for distribution in September, the Public Health Service is preparing for publication a series of booklets for children of various age levels. The first, *We Grow Up*, a booklet for adolescents, is now ready for distribution.

LAWRENCE KOLB,
Ass't Surgeon General,
U. S. Public Health Service

SCHEINFELD, AMRAM. *You and Heredity.* New York: Frederick A. Stokes and Company. 1939. 434 pp. $3.00.

We have long been in need of a comprehensive presentation of our present knowledge as to human heredity, written in an interesting fashion for the layman and the beginner in science. Mr. Scheinfeld has here done an admirable job in fulfilling such a need.

The mechanism of human inheritance is first presented in as simple and logical a fashion as is possible for such a topic. Then, in short, readable chapters are summarized our knowledge as to the mode of inheritance of structure, physiology, talent, and personality.

A few chapter headings may serve as a clue to the method of approach. They include: "Life Begins at Zero"; "Myths of Mating"; "Peas, Flies and People"; "The Dionnes"; "How Long Will You Live?"; and "The Battle of the IQ's."

The results of a special investigation into the inheritance of musical talent are presented.

A large number of graphic charts, diagrams, and drawings play an important part in "humanizing" and clarifying the text.

The book is, in this reviewer's opinion, a "must" for biology teachers and advanced secondary students, both as a general presentation and as a source of reference.

RUTH SHERMAN

THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS ☐ NEW
MR. P. K. HOUDEK, *Sec'y-Treas.* ☐ RENEWAL
ROBINSON, ILLINOIS

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